6.1 ALTERNATIVE 1: NO ACTION

6.1.1 TECHNICAL CRITERIA

Under a No Action Alternative, a technical evaluation of system performance, implementability and reliability is not applicable.

6.1.2 ENVIRONMENTAL CRITERIA

The No Action Alternative will not address the facility conditions and pathways of contamination, and could result in unacceptable human and environmental exposures to the chemicals of concern. Alternative 1 will not meet the environmental criteria.

6.1.3 INSTITUTIONAL CRITERIA

The No Action Alternative will not provide deed restrictions, permits for discharge of air or wastewater, zoning permits, or other institutional means of restricting or preventing exposure to VOCs. The no action alternative may not prevent human off-site exposure to concentrations of site-related chemicals at concentrations above the remedial action objectives and so will not satisfy the institutional criteria.

6.2 ALTERNATIVE 2: INSTITUTIONAL CONTROLS; MONITORING

ALTERNATIVE 2A: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER EXTRACTION AND TREATMENT WITH AIR STRIPPING

6.2.1 TECHNICAL CRITERIA

Alternative 2 incorporating institutional controls and groundwater monitoring provides a non-technology based corrective action. As a passive approach, this alternative does not provide for remediation of the source area and may allow the off-site migration of VOCs. Although natural degradation processes may be active in the soil and the Unit B aquifer to reduce contaminant concentrations, the continued migration of contaminants from the site is not desirable. This alternative also does not address the interception of groundwater by the storm sewer routed through the site. Therefore, Alternative 2 does not meet the performance objectives of the CMS. However, the implementation of institutional controls will reduce the risk to the general public, public utility workers, and on-site personnel, and a comprehensive monitoring program will document changes in subsurface impacts and potential risk to public health and safety.

Monitoring provides a reliable means to document the change in the concentration of impacts to groundwater and soil in the Unit B aquifer and to describe subsurface conditions in Area 3. Limited

historical data are available to establish trends in VOC concentrations in some locations, and additional data may be beneficial to identify these trends.

Periodic monitoring is readily implementable. The scope of monitoring would include groundwater sampling and VOC analysis at existing on-site and off-site groundwater monitoring wells, the installation and sampling of approximately three new off-site monitoring wells located along Forsythe Street, and the sampling and analysis of on-site impacted soil or soil gas.

Monitoring does not present a risk to public health and safety, to the well installation contractor, or to the technician obtaining samples from the site provided that proper health and safety requirements are followed.

Alternative 2A incorporates the existing ICM system of groundwater extraction and treatment by air stripping in order to prevent the interception and conveyance of impacted on-site groundwater to Hurricane Creek. It is anticipated that the ICM will perform satisfactorily to reduce groundwater elevation in the vicinity of the storm sewer to below the pipe invert and to remove and treat impacted groundwater present on the site. Depending on the actual drawdown obtained at the extraction wells, off-site impacted groundwater may also be captured and treated. Because extraction well RW-3 is located near the source area, enhanced treatment of the groundwater and soils in this area is anticipated. Therefore, the potential for Alternative 2A to achieve performance goals is considered moderate for on-site impacted soil, high for on-site impacted groundwater, moderate for off-site impacted groundwater, and high for surface water.

The technology utilized in the ICM is considered reliable with low operation and maintenance requirements.

Because the ICM is in operation, it is considered highly implementable. The impact of reducing the water table to below the invert of the storm sewer should be realized soon after the implementation of the system.

The implementation of the ICM does not present any unnecessary risk to the health and safety of the general public, on-site personnel, or the treatment system operator provided that proper health and safety requirements are followed.

6.2.2 ENVIRONMENTAL CRITERIA

Alternative 2 will effectively control human and environmental exposures to the chemicals of concern in the short-term, but could result in unacceptable exposures in the long term if the chemicals migrate beyond the area covered by deed or regulatory restrictions. Alternative 2A will prevent human and environmental exposure to chemicals at the site and to chemicals that migrated from the site along the storm sewer. Alternative 2 does not meet the environmental criteria because it does not address chemicals that may

continue to migrate from the site in the storm sewer. Alternative 2A does control human exposure and mitigates migration of chemicals in the storm sewer and so meets the environmental criteria.

6.2.3 INSTITUTIONAL CRITERIA

Alternatives 2 and 2A may protect human health and the environment by the use of institutional controls to eliminate potential exposures to the impacted soil and groundwater. For Alternate 2, it is unlikely that institutional controls can be used to limit exposure to impacted groundwater flowing into Hurricane Creek through the storm sewer. A monitoring program will provide information to evaluate the need for additional actions. The institutional controls would be required until the monitoring program demonstrates that all of the remedial objectives had been achieved.

Alternative 2 may require the following institutional controls:

- Deed restrictions or local regulations restricting the use of the site, use of on-site groundwater, and use of off-site groundwater;
- A groundwater monitoring program for the on-site groundwater and storm sewer water;
- A soil monitoring program (if necessary);
- Implementation of standard confined space entry procedures for sewers and manholes that may have been impacted;
- Local permits for installation of monitoring wells along the right-of-way of Forsythe Street; and
- Fencing of the site, which may be subject to local zoning requirements.

Alternative 2A may require the following additional institutional controls:

- Local permits and compliance with building codes and zoning regulations for construction and operation of the air stripper;
- An air discharge permit for the air stripper (this was found not be necessary for the ICM);
- A state permit for the construction of the air stripper (this was obtained for the ICM); and
- A local permit to discharge treated water to the city wastewater treatment plant (this was obtained for the ICM).

Alternative 2 will prevent human exposure to concentrations of site-related chemicals at concentrations above the remedial action objectives and so would probably satisfy the institutional criteria in the short-term. However, in the long-term, Alternative 2 could allow some site-related chemicals in groundwater to flow off-site, which could increase the time needed to achieve the remedial action objectives and possibly the area of impacted groundwater off-site. Therefore, Alternative 2 would require a more extensive monitoring program to evaluate the effectiveness of the institutional controls.

Alternative 2A would prevent site-related chemicals from leaving the site via the storm sewer and will meet the institutional criteria.

6.3 ALTERNATIVE 3: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER EXTRACTION AND TREATMENT WITH AIR STRIPPING; GROUNDWATER SPARGING; SOIL VAPOR EXTRACTION

6.3.1 TECHNICAL CRITERIA

An evaluation of the institutional controls and groundwater monitoring relative to technical criteria is presented in Section 6.2.1 and not repeated here.

An evaluation of the groundwater extraction and treatment with air stripping (ICM) relative to technical criteria is presented in Section 6.2.1 and not repeated here.

Groundwater sparging and SVE are proven technologies and are expected to be effective for the treatment of volatile contaminants in both the soil and groundwater. These two technologies are particularly well suited for this application because impacted soil is at or below the water table. Air sparging will not only remove VOCs from the groundwater, but will also enhance volatilization of VOCs associated with the soil. SVE, then, will extract the volatilized compounds from the vadose zone and discharge them to atmosphere. Groundwater sparging and SVE wells would be located along the southern property boundary to provide treatment for impacted groundwater prior to leaving the site. Additional wells would be located in the source area near the sanitary sewer break to reduce contaminant concentrations and reduce the potential for off-site migration of contaminants. Specific design criteria for the groundwater sparging and SVE system may need to be developed through on-site pilot testing. The potential for the combined technologies utilized in Alternative 3 to achieve performance goals are considered high for on-site soils, high for on-site groundwater, moderate for off-site groundwater, and high for surface water.

Groundwater sparging and SVE do not require unusual or complicated operation and maintenance procedures and a properly monitored and maintained system should provide for reliable operation.

A groundwater sparging and SVE system can easily be implemented on the site. Well installation can easily be accomplished using conventional techniques. Standard (packaged) equipment is available for both air sparging and SVE. The installation of all wells would be on the facility property, eliminating the need to obtain easements or approvals for off-site work.

The installation and operation of an air sparging and SVE system does not present any unusual risk to the health and safety of the general public, to on-site personnel, or to the treatment system operator provided that proper health and safety requirements are followed.

6.3.2 ENVIRONMENTAL CRITERIA

Alternative 3 will control human exposure and mitigate migration of chemicals in the storm sewer and so meets the environmental criteria.

6.3.3 INSTITUTIONAL CRITERIA

Alternative 3 will protect human health and the environment by the use of institutional controls to prevent potential human exposure to the impacted soil and groundwater, active remediation of soil and groundwater, and preventing impacted groundwater from entering the storm sewer and flowing off the site. The institutional controls will be required until the monitoring program demonstrates that the remedial objectives have been achieved. A monitoring program will provide information to evaluate the need for additional actions.

Alternative 3 involves the same institutional criteria as Alternative 2 plus the following additional criteria for disposal of treated groundwater:

- A NPDES permit for discharge into the storm sewer, or a local permit to discharge treated water to the city wastewater treatment plant.
- An air discharge permit may be required for the sparging/SVE system.

Alternative 3 will meet the institutional criteria.

6.4 ALTERNATIVE 4: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER EXTRACTION AND TREATMENT WITH AIR STRIPPING; SOIL EXCAVATION, AERATION, AND BACKFILL

ALTERNATIVE 4A: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER EXTRACTION AND TREATMENT WITH AIR STRIPPING; SOIL EXCAVATION, AND OFF-SITE DISPOSAL

6.4.1 TECHNICAL CRITERIA

An evaluation of the institutional controls and groundwater monitoring relative to technical criteria is presented in Section 6.2.1 and not repeated here.

An evaluation of the groundwater extraction and treatment with air stripping (ICM) relative to technical criteria is presented in Section 6.2.1 and not repeated here.

Excavation of impacted soils from the source area will have limited effectiveness in removing the most severely impacted soils because contaminated soil is at or below the water table near the property boundary, and near buried utilities. The ability of this corrective measure alternative to meet the performance objectives is considered moderate for on-site soil since not all of the impacted soil will be removed from the site, moderate for on-site groundwater because only a portion of the contaminant source is being removed, and moderate for off-site groundwater because the removal of impacted soil will minimize the transfer of additional VOCs to the groundwater having a potential to migrate off-site. Once excavated, impacted soil would be treated using passive aeration. Given sufficient time, passive aeration is expected to achieve the treatment objectives for the excavated soils.

The reliability of soil excavation combined with passive aeration for achieving the performance objectives is considered moderate to high for on-site soil, moderate for on-site groundwater because the removal of the soil will reduce the transfer of additional contaminants to the groundwater, and moderate for off-site groundwater because the removal of impacted soil will minimize the transfer of additional contaminants to the groundwater having a potential to migrate off-site.

The implementability of the soil excavation option is considered low to moderate for the following reasons: (1) much of the impacted soil is below the water table requiring extensive dewatering of the site to accommodate excavation; (2) the excavation would likely extend down a minimum of 20 feet below grade resulting in a large affected area at the ground surface assuming a 1:1 side slope for the excavation; and (3)

the excavation would be performed near a property boundary and would likely infringe on the neighboring property owner, requiring Amphenol to obtain special permits to work off-site.

The risk presented by this corrective measure alternative to the health and safety of the general public is considered high because soils undergoing treatment will be exposed for a period of time resulting in increased likelihood of exposure, and the large excavation could pose a risk to neighborhood residents even if appropriate safeguards are in place. The risk of the corrective measure alternative to the health and safety of the workers during implementation is considered moderate because of potential exposure to VOCs during excavation, the possibility of failure of the excavation walls and handling of impacted soils.

6.4.2 ENVIRONMENTAL CRITERIA

Alternatives 4 and 4A control human exposure and mitigate migration of chemicals in the storm sewer and so meet the environmental criteria.

6.4.3 INSTITUTIONAL CRITERIA

Alternatives 4 and 4A will protect human health and the environment by the use of institutional controls to prevent potential human exposure to the impacted soil and groundwater, active remediation of soil and groundwater, and preventing impacted groundwater from entering the storm sewer and flowing off the site. The institutional controls will be required until the monitoring program demonstrates that the remedial objectives have been achieved. A monitoring program would provide information to evaluate the need for additional actions.

Alternatives 4 and 4A involve the same institutional criteria as Alternative 2 plus the following additional criteria related to the excavation and treatment of soil:

- On-site soil treatment may require an air permit and will require control of erosion and runoff from impacted soils being treated on site (Alternative 4).
- Off-site disposal of the soils would require incineration at a permitted facility and disposal of incinerated soils at a permitted facility (Alternative 4A).

6.5 ALTERNATIVE 5: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER EXTRACTION AND TREATMENT WITH AIR STRIPPING (ICM); FOCUSED GROUNDWATER SPARGING AND SOIL VAPOR EXTRACTION

6.5.1 TECHNICAL CRITERIA

An evaluation of the institutional controls and groundwater monitoring relative to technical criteria is presented in Section 6.2.1 and not repeated here.

An evaluation of the groundwater extraction and treatment with air stripping (ICM) relative to technical criteria is presented in Section 6.2.1 and not repeated here.

Alternative 5 utilizes the same technologies as Alternative 3 but provides a focused application of air sparging and SVE in the area of soils having the highest impact from VOCs should continued use of the ICM prove ineffective or too slow in reducing those levels of VOCs. The ability of the technologies utilized in this alternative to meet the corrective measure objectives is considered to be high for on-site impacted soils, high for on-site impacted groundwater because the alternative is focused on a source of impacts for groundwater, moderate for off-site groundwater because of reduced potential for additional off-site migration of VOCs, and high for surface water.

The reliability of the alternative to meet corrective measure objectives is considered high because the operation and maintenance requirements of the system components are considered to be low.

The implementability of the corrective measure alternative is considered high because all construction is within the property boundary and conventional techniques can be used for the installation of wells.

The risk presented by this alternative to the general public, on-site personnel, and the treatment system operator is considered low because the construction is non-obtrusive and the system would be designed to collect volatilized contaminants and discharge them to the atmosphere in compliance with applicable air quality criteria, thus minimizing potential impacts at the ground surface.

6.5.2 ENVIRONMENTAL CRITERIA

Alternative 5 controls human exposure and mitigates migration of chemicals in the storm sewer, and so meets the environmental criteria.

6.5.3 INSTITUTIONAL CRITERIA

Alternative 5 will protect human health and the environment by the use of institutional controls to eliminate potential human exposures to the impacted soil and groundwater, active remediation of soil and groundwater, and preventing impacted groundwater from entering the storm sewer and flowing off the site. The institutional controls will be required until the monitoring program demonstrates that the remedial objectives have been achieved. A monitoring program would provide information to evaluate the need for additional actions.

Alternative 5 involves the same institutional criteria as Alternative 2 plus the following requirements for air sparging/SVE:

- A NPDES permit for discharge to the storm sewer, or a local permit to discharge treated water to the city wastewater treatment plant.
- An air discharge permit may be required for the sparging/SVE system.

Alternative 5 meets the institutional criteria.

6.6 ALTERNATIVE 6: INSTITUTIONAL CONTROLS; MONITORING; GROUNDWATER TREATMENT WITH AIR STRIPPING AND CARBON ADSORPTION POLISHING; REINJECTION OF TREATED WATER TO PROMOTE SOIL FLUSHING

6.6.1 TECHNICAL CRITERIA

An evaluation of the institutional controls and groundwater monitoring relative to technical criteria is presented in Section 6.2.1 and not repeated here.

An evaluation of the groundwater extraction and treatment with air stripping (ICM) relative to technical criteria is presented in Section 6.2.1 and not repeated here.

Alternative 6 provides air stripping of groundwater and reinjection of treated water to promote soil flushing. The ability of the technologies utilized in this alternative to meet the corrective measure objectives is considered to be moderate for on-site impacted soils, high for on-site impacted groundwater, moderate for off-site groundwater because of reduced potential for additional off-site migration of VOCs, and high for surface water.

The reliability of the alternative to meet corrective measure objectives is considered high because the peration and maintenance requirements of the system components are considered low.

The implementability of the corrective measure alternative is considered high because all construction is within the property boundary and conventional techniques can be used for the installation of wells.

The risk presented by this alternative to the general public, on-site personnel, and the treatment system operator is considered low because the construction is non-obtrusive and the system is design to collect volatilized contaminants and discharge then to the atmosphere, thus minimizing potential impacts at the ground surface.

6.6.2 ENVIRONMENTAL CRITERIA

Alternative 6 controls human exposure and mitigates migration of chemicals in the storm sewer and so meets the environmental criteria.

6.6.3 INSTITUTIONAL CRITERIA

Alternative 6 will protect human health and the environment by the use of institutional controls to eliminate potential human exposures to the impacted soil and groundwater, active remediation of soil and groundwater, and preventing impacted groundwater from entering the storm sewer and flowing off the site. The institutional controls will be required until the monitoring program demonstrates that the remedial objectives have been achieved. A monitoring program would provide information to evaluate the need for additional actions.

Alternative 6 involves the same institutional criteria as alternative 3 plus a groundwater reinjection permit or permit exemption. Alternative 6 meets the institutional criteria.

7.0 COST ESTIMATES

The capital cost for implementing each remedial alternative has been estimated and the details are provided in Appendix B. Annual operating costs for each alternative have also been estimated and the details are provided in Appendix C.

Unit costs for some items in the estimates were taken from the 1995 Editions of *Means Construction Costs* and the *ECHOS Environmental Restoration Costs* estimation catalogs. Other costs utilized were based on vendor quotes and past experience with similar remediation equipment and construction services. Costs for shipping, engineering, construction management, and contingencies were calculated as a percentage of either the total equipment costs or total installed cost, as noted in the cost estimate assumptions.

All alternatives, excluding Alternative 1 (the No Action Alternative), include operating costs for regular soil and groundwater monitoring and the initiation of institutional controls for the site and surrounding areas. Complete groundwater monitoring was deemed to require the installation of three additional monitoring wells along Forsythe Street. Institutional controls deemed necessary for the site included deed restrictions on the use of the former Amphenol site and on the recovery of shallow groundwater in the impacted areas. In addition, a recommendation to both municipal and private utilities regarding the initiation of standard confined space entry procedures when entering manholes in the impacted areas was considered appropriate.

All alternatives, excluding Alternatives 1 and 2, also include operating costs for the continued operation of the Interim Control Measure (ICM) air stripper installed on site. The groundwater recovery and air stripping system was installed to capture impacted groundwater and to remove the VOCs, prior to the discharge of the water to the sanitary sewer. The discharge of the treated water off-site was intended to effect a lowering of the groundwater table in the area of the storm sewer, preventing the site groundwater from being intercepted and transmitted to the outfall at Hurricane Creek.

Alternatives 3, 4, 4-A, 5, and 6 all include remedial technologies in addition to the ICM air stripping system. While generally increasing the overall cost of both the capital and operating expenses, the addition of these remedial technologies was intended to enhance and expedite the final remediation of the site. A summary of the capital and operating costs for each of the eight alternatives is presented in Table 7.1.

8.0 RECOMMENDATION AND JUSTIFICATION OF THE SELECTED CORRECTIVE MEASURE ALTERNATIVE

8.1 RECOMMENDED CORRECTIVE MEASURE ALTERNATIVE

Based on the available data indicating both the on-site and off-site impacts, the recommended corrective measure is Alternative 5 incorporating institutional controls, monitoring of both on-site and off-site monitoring wells for selected VOCs in groundwater, monitoring of on-site impacted soil for select VOCs (if necessary), the installation of additional monitoring wells along Forsythe Street. Data from these wells will allow more effective observation of the level and fate of VOC impacts in soil and groundwater media, and effects of continued operation of the existing extraction wells and air stripper (ICM), and the implementation of a focused on-site groundwater sparging and SVE.

8.2 JUSTIFICATION OF THE RECOMMENDED CORRECTIVE MEASURE ALTERNATIVE

The implementation of institutional controls presents a logical first step and an easily implementable mechanism to reduce risk to the general public. Local restrictions on the use of groundwater would not present a hardship on the surrounding community since a public water utility provides potable water service to all residences and businesses in the area. Additional signage on site and notification to local utilities recommending the use of standard confined space entry procedures, including monitoring for VOCs and oxygen deficient conditions, simply stresses the use of practices which should already be part of standard operating procedures. Deed restrictions limiting on-site excavation in severely impacted areas does not present unreasonable restrictions on the current site property owner.

Semi-annual monitoring of specific constituents in on-site impacted groundwater and, if necessary, soil is recommended to better characterize the fate of impacts in these areas and to measure the performance of implemented remedial actions. Water level data obtained from monitoring wells located near the storm sewer will provide a measure of the ability of the ICM to lower the water table and provide useful data necessary to help define the extent of influence of the extraction wells.

Semi-annual monitoring of specific parameters in surface water discharged at the storm sewer outfall to Hurricane Creek will be used to determine the performance of the ICM to eliminate the off-site transport of impacted groundwater through the storm sewer.

Semi-annual monitoring of specific constituents in off-site impacted groundwater along Forsythe Street will be facilitated by the installation of three permanent monitoring wells along Forsythe Street and Ross Court. Data obtained from these wells will allow better characterization of the fate of impacts in this area.

An interim corrective measure consisting of three extraction wells and an air stripper has been installed on site and is currently operating. The objectives of the ICM are (1) to lower the water table in the vicinity of the storm sewer to below the invert of the sewer to prevent the transport of impacted groundwater through the storm sewer and into Hurricane Creek, and (2) to provide for the extraction and treatment of impacted groundwater from the site. In addition, pumping from the extraction wells may cause a reversal of groundwater flow in the vicinity of the property boundary and provide capture of some off-site impacted groundwater. The incorporation of the ICM as an element of the recommended corrective measure alternative is justifiable considering both cost and risk based criteria. As indicated in the risk assessment conclusions contained in the RFI, exposure through surface water contact does not pose an unacceptable risk. However, if effective, the ICM will further reduce any health risk associated with exposure through this pathway. Because the ICM is already a functioning system, no additional capital investment is

required to include this technology as a part of the recommended corrective measure alternative. The technology does not present any unusual operation and maintenance requirements or excessive operating cost.

Because the majority of impacted soils are below the water table, continued operation of the ICM will result in some reduction in soil VOC concentrations over time. However, the severe impact present in the vicinity of the sanitary sewer break on-site will likely continue to be a source for contaminant migration if not adequately addressed. Should operating data suggest that the ICM is ineffective in reducing VOC levels in on-site soils or that the overall corrective action would benefit from an expedited reduction of soil VOC levels, Alternative 5 also includes the focused application of groundwater sparging and SVE in addition to the ICM. Both air sparging and SVE technologies are well suited for the site due to the volatile nature of the impacts and the sandy characteristics of the Unit B aquifer. While the presence of impacted on-site soils, on-site groundwater and off-site groundwater does not present an unacceptable risk to human health of the environment, the severely impacted soils are proximate to a property boundary. These technologies, although installed on-site, can still provide treatment beyond the property boundary.

Other techniques for soil remediation such as excavation present a number of drawbacks. Excavation would be highly intrusive within the property boundary and the excavation will likely extend beyond the property boundary, affecting the neighboring residential property owner. Excavation presents additional risks to workers because of direct exposure to soils containing high concentrations of VOCs. Because contaminated soil is below the water table, extensive dewatering and treatment of water high in VOCs would be required. Treatment of the excavated soils on site provides increased exposure potential for workers, the employees and residents alike. The off-site transportation of soils for remediation potentially adds risk to both Amphenol and Franklin Power Products. In short, excavation substantially increases risk over the selected corrective measure technology.

Alternative 6 utilizing groundwater extraction and reinjection of treated water to promote soil flushing presents the apparent lowest cost alternative, but is not the recommended alternative. Based on the evaluation criteria summarized in Table 6.1, Alternative 6 was determined to be only moderately effective for the remediation of impacted soils because of the time required to complete the soil flushing process. The selected remedial alternatives would provide a more focused application of the remedial action near the source area with the potential for reducing the overall time frame for remediation.

The operation of the ICM and the focused groundwater sparging/SVE will impact groundwater flow and result in sufficient site remediation to prevent future off-site migration of VOCs above acceptable levels. However, should additional monitoring data indicate that impacted groundwater is migrating off-site onto

the neighboring residential property, then the scope of the groundwater sparging and SVE could be expanded to include the installation of additional wells as described in corrective measure Alternative 3.

The recommended corrective measure alternative proposes groundwater monitoring for most off-site impacts and particularly for impacts along Forsythe Street. The location and nature of the impacts, not addressed by other elements of the recommended corrective measure alternative, do not pose an unacceptable risk to the public health and the environment. Therefore, immediate corrective action is not warranted. Because the area of the impacts is residential, active remediation in this area would also prove to be highly disruptive to the neighboring residents.

Data describing impacts to off-site groundwater are limited to samples collected by Geoprobe sampling during Fall 1993 and Spring 1994. The recommended remedial action includes the installation of permanent monitoring wells along both Forsythe Street and Ross Court to observe over time groundwater impacts in this area. These wells would also facilitate the collection of additional data necessary to effectively evaluate remedial alternatives for impacted groundwater in this area if required. Useful data resulting from the installation and sampling from these permanent monitoring wells would include soil classification, permeability, aquifer thickness, water levels, and contaminant concentrations. Routine sampling from these monitoring wells will provide data necessary to assess the fate of impacted groundwater and the potential for continued contaminant migration. Data may indicate that natural attenuation mechanisms, including bioutilization, are reducing contaminant concentrations. However, if the evaluation of the data determine that remedial action is required, then soil vapor extraction with air sparging and groundwater extraction and treatment technologies will be evaluated based on all available data.

TABLE 4.1

INITIAL ICM PERFORMANCE DATA

Former Amphenol Site
Franklin, Indiana

Well ID	Top of Casing Elevation (feet, MSL	Initial Conditions, 2/14/95		2/16/95 to 2/23/95		2/23/95 to 3/2/95		Change in Water Elevation (feet)
		Depth to Water (feet)	Water Elevation (feet, MSL)	Depth to Water (feet)	Water Elevation (feet, MSL)	Depth to Water (feet)	Water Elevation (feet, MSL)	
IT-2	732.25	13.00	719.25	13.25	719.00	13.15	719.10	-0.15
IT-3	728.71	11.10	717.61	11.20	717.51	11.18	717.53	-0.08
MW-3	736.44	16.53	719.91	16.55	719.89	16.49	719.95	+0.04
MW-9	733.04	12.11	720.93	11.82	721.22	11.80	721.24	+0.31
MW-12	736.38	17.06	719.32	17.28	719.10	17.27	719.11	-0.21
MW-20	734.03	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MW-21	737.91	18.06	719.85	18.03	719.88	18.02	719.89	+0.04
MW-22	737.64	17.97	719.67	18.03	719.61	18.12	719.52	-0.15
MW-24	736.02	16.55	719.47	16.85	719.17	16.55	719.47	0.0
MW-26	736.39	15.48	720.91	15.81	720.58	15.19	721.20	+0.29
MW-27	736.63	16.76	719.87	16.54	720.09	16.60	720.03	+0.16
MW-28	738.04	18.27	719.77	18.18	719.86	18.21	719.83	+0.06
MW-29	737.61	18.03	719.58	17.92	719.69	17.92	719.69	+0.11
MW-30	734.84	15.74	719.10	15.70	719.14	15.72	719.12	+0.02

Notes:

(1) RW-1: Pumped approximately 5,760 gallons during the time period 2/16/95 to 3/2/95.

(2) RW-2: Pumped approximately 65,047 gallons (3.3 gpm) during the time period 2/16/95 to 3/2/95.

(3) RW-3: Pumped approximately 110,993 gallons (5.5 gpm) during the time period 2/16/95 to 3/2/95.

(4) n/a - data not available

TABLE 4.2

SUMMARY OF ICM ANALYTICAL DATA

Former Amphenol Site
Franklin, Indiana

DATE	INFLUENT TVOC (µg/l)			EFFLUENT TVOC (µg/l)
	RW-1	RW-2	RW-3	
03/09/95	1,275	5,159	2,561	ND
03/29/95	910	4,843	2,638	3.3
05/03/95	853	6,819	3,628	ND
08/03/95	761	5,648	1,499	ND

ND = Not present above method detection limits.

TABLE 4.3

CUMULATIVE GROUNDWATER PUMPAGE FOR ICM

Former Amphenol Site
Franklin, Indiana

DATE	CUMULATIVE PUMPAGE (gallons)				AVERAGE FLOW RATES (gpm)			
	RW-1	RW-2	RW-3	TOTAL	RW-1	RW-2	RW-3	TOTAL
02/24/95	0	0	0	0	0	0	0	0
03/03/95	20,984	31,644	80,228	132,856	1.1	1.7	4.3	7.1
03/29/95	84,695	88,774	152,228	325,697	2.2	2.0	2.5	6.7
04/14/95	136,654	133,675	224,228	494,557	2.3	2.0	2.5	6.7
05/03/95	200,683	193,729	284,420	678,832	2.3	2.2	2.2	6.7
05/14/95	237,115	228,577	319,268	784,960	2.3	2.2	2.2	6.7
05/18/95	255,043	245,727	354,116	854,886	4.1	4.0	4.0	12.1
05/23/95	255,043	245,727	354,116	854,886	0	0	0	0
05/26/95	276,211	266,031	374,420	916,662	4.9	4.7	4.7	14.3
06/19/95	445,555	428,463	536,852	1,410,870	4.9	4.7	4.7	14.3

TABLE 5.1

GROUNDWATER AND SOIL ARARs

Former Amphenol Site
Franklin, Indiana

Chemical	Final Risk-Based PRG Concentrations for Soil (residential) (mg/kg)	Final Risk-Based PRG Concentrations for Ground Water (ug/L)	Maximum Contaminant Level (MCL) (ug/L)	Maximum Contaminant Level Goal (MCLG) (ug/L)	RCRA Subpart S Action Levels (P)	
					Soil (mg/kg)	Ground Water (ug/L)
Acetone	27400	3650	#N/A	#N/A	8000	4000
2-Butanone	164000	2500	#N/A	#N/A	50000	20000
Carbon tetrachloride	4.91	0.259	5	Zero	5	MCL
Chloroform	105	0.275	80(T)	Zero	100	MCL
1,1-Dichloroethane	27400	768	#N/A	#N/A	8000	4000
1,1-Dichloroethylene	1.06	0.0167	7	7	10	MCL
1,2-Dichloroethene	2460	329	70(cis)	70(cis)	700	MCL
Methylene Chloride	85.2	6.31	5	Zero	90	MCL
4-Methyl-2-pentanone	21900	183	#N/A	#N/A	6000	3000
Tetrachloroethene	12.3	1.43	5	Zero	10	MCL
Toluene	1.6	0.213	1000	1000	2	MCL
1,1,1-Trichloroethane	24600	1550	200	200	7000	MCL
Trichloroethene	58.1	2.54	5	Zero	60	MCL
Xylene, total	548000	73000	10000	10000	200000	MCL
Aluminum	#N/A	#N/A	50(S)	#N/A	#N/A	#N/A
Antimony	110	14.6	6	6	30	MCL
Arsenic	0.355	0.0473	50(U)	#N/A	0.4	MCL
Barium	19200	2560	2000	2000	5000	MCL
Beryllium	0.149	0.0198	4	4	0.2	MCL
Cadmium	137	18.3	5	5	40	MCL
Calcium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Chromium, VI	1370	183	100(total)	100(total)	400	MCL
Cobalt	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Copper	10200	1350	1300(A)	1300	3000	MCL
Cyanide	5480	730	200(P)	200(P)	2000	700
Iron	#N/A	#N/A	300(S)	#N/A	#N/A	#N/A
Lead	#N/A	#N/A	15(A)	Zero	#N/A	MCL
Magnesium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Manganese	1370	183	50(S)	#N/A	10000	700
Mercury	82.1	11	2	2	20	MCL
Nickel	5480	730	100	100	2000	MCL
Potassium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Selenium	1370	183	50	50	400	MCL
Silver	1370	183	100(S)	#N/A	400	200
Sodium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Thallium	21.9	2.92	2	0.5	6	MCL
Tin	164000	21900	#N/A	#N/A	50000	20000
Vanadium	1920	256	#N/A	#N/A	500	200
Zinc	82100	11000	5000(S)	#N/A	20000	10000

#N/A = Not available

ARAR = Applicable or Relevant and Appropriate Requirements.
PRG = Preliminary Remediation Goal (health-based).
(T) = this value for total trihalomethanes.
(P)=Proposed (S)=Secondary standard
(A)=Action Level
(U) = Under review.
MCLs and MCLGs are from "Drinking Water Regulations and Health Advisories", U.S. EPA, May 1994.
Action Levels were calculated according to the recommended assumptions given in the propsed Subpart S rules.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils	No Action	None	Not Applicable	Yes	The No Action Alternative will be carried through to the Detailed Analysis of Alternatives.
	Institutional Action	Access Restriction	Deed Restrictions	Yes	Restrictions on excavation and soil use in impacted areas may be applicable. Must be coordinated with property owner(s) and public agencies.
			Site Fencing	No	Impacted soils are mainly at a depth of >15 feet. Restricting access to site will not affect potential contact with impacted soils.
		Monitoring	Soil Monitoring	Yes	On-going monitoring of site soils may be applicable.
	Surface Water Diversion	Surface Controls	Grading	No	Site already graded for runoff control.
			Soil Cover/ Revegetation	No	Site already has vegetative cover or paving.
			Flood Control Dikes	No	Not necessary due to site elevation and stratigraphy.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils (cont.)	Containment	Capping (single layer)	Synthetic Membrane	No	May minimize surface water infiltration, but will not affect groundwater flow through impacted soil.
			Natural Soil	No	Site already has natural soil cover.
			Clay	No	May minimize surface water infiltration, but will not affect groundwater flow through impacted soil.
			Asphalt	No	May minimize surface water infiltration, but will not affect groundwater flow through impacted soil.
			Concrete	No	May minimize surface water infiltration, but will not affect groundwater flow through impacted soil.
		Capping (multi-layer)	Multimedia	No	May minimize surface water infiltration, but will not affect groundwater flow through impacted soil.
		Vertical Barriers	Slurry Wall	No	Hydrogeology and vertical extent of groundwater site will limit the effectiveness of a slurry wall.
			Vibrating Beam Bitumen Grout Wall	No	Forms barrier with uncertain integrity due to difficulty in sealing base of wall.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils (cont.)	Containment (cont.)	Vertical Barriers (cont.)	Grout Curtain	No	Forms barrier of uncertain integrity.
			Metallic Sheet	No	Presence of storm and sanitary sewers in area will not allow driving of sheet pile.
			Concrete Wall	No	Freeze/thaw stresses will cause cracking of concrete, producing a barrier of uncertain integrity.
			Clay Wall	No	May be effective in limiting migration of contaminants from source area.
		Horizontal Barriers	Block Displacement	No	Horizontal barrier is not beneficial for impacted soil below the water table where there is lateral groundwater movement.
			Injection Grouting	No	Horizontal barrier is not beneficial for impacted soil below the water table where there is lateral groundwater movement.
	Removal	Excavation	Mechanical Excavation	Yes	Localized excavation of impacted soils may be effective; either independently or coupled with other technologies. Most impacted soils are at depths >15 feet.
			Consolidation	No	Estimated volumes of soils and type of contamination inappropriate for consolidation.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils (cont.)	On-site Treatment	Thermal Oxidation	Rotary Kiln	No	Volume of impacted soil is too small for on-site incineration.
			Liquid Injection	No	Not applicable due to contaminant characteristics.
			Fluidized Bed	No	Not applicable due to contaminant characteristics.
			Infrared	No	Volume of impacted soil is too small for on-site incineration.
		Direct Treatment	Aeration	Yes	May be effective in removing contaminants from soil.
			Slurry Degradation	No	Inappropriate due to contaminant characteristics.
			Low Temperature Thermal Desorption	Yes	May be effective in removing contaminants from soil.
			Soil Washing	No	Inappropriate due to volatile nature of contaminants.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils (cont.)	On-Site Treatment (cont.)	In-Situ Treatment	Microbial Degradation	No	Lack of performance data on chlorinated contaminants.
			Oxidation (chemical detoxification)	No	Inappropriate due to aromatic nature of contaminants.
			Stabilization/ Solidification	No	Inappropriate due to contaminant characteristics.
			Soil Flushing	Yes	May be effective in enhancing removal of contaminants from soil matrix.
			Soil Aeration	Yes	May be effective in removing contaminants from soil matrix.
			Soil Vapor Extraction	Yes	May be effective in removing contaminants from soil matrix.
			Vitrification	No	Cannot be implemented due to site conditions, high water table.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Soils (cont.)	Off-Site Treatment	RCRA Incineration	Incineration	Yes	Incineration may be required for off-site disposal.
	On-Site Disposal	RCRA Landfill Construction	Not Applicable	No	Physical location of site makes it inappropriate for constructing a landfill.
		Type II Landfill Construction	Not Applicable	No	Physical location of site makes it inappropriate for constructing a landfill.
	Off-Site Disposal	RCRA Landfill	Not Applicable	No	Incineration required prior to disposal. RCRA landfill is not required.
		Type II Landfill	Not Applicable	Yes	Following incineration, soil can be disposed of in a Type II landfill.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater	No Action	None	Not Applicable	Yes	The No Action Alternative will be carried through to the Detailed Analysis of Alternatives.
	Institutional Action	Access Restriction	Deed Restrictions	Yes	Deed restrictions on well installation and groundwater use may be appropriate.
			Site Fencing	No	Site fencing will not restrict groundwater exposure.
		Monitoring	Groundwater Monitoring	Yes	On-going monitoring of on-site and off-site wells may be applicable.
	Surface Water Diversion	Surface Controls	Grading	No	May be applicable if soil excavation is utilized, but will not affect groundwater flow through impacted soil.
			Soil Cover/ Revegetation	No	Site already has vegetative cover or paving.
			Flood Control Dikes	No	Not necessary due to site elevation and stratigraphy.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater (cont.)	Containment	Capping (single layer)	Synthetic Membrane	No	May minimize surface water infiltration, but will not impact upstream recharge of groundwater and leaching of contaminants.
			Clay	No	May minimize surface water infiltration, but will not impact upstream recharge of groundwater and leaching of contaminants.
			Asphalt	No	May minimize surface water infiltration, but will not impact upstream recharge of groundwater and leaching of contaminants.
			Concrete	No	May minimize surface water infiltration, but will not impact upstream recharge of groundwater and leaching of contaminants.
		Capping (multi-layer)	Multimedia	No	May minimize surface water infiltration, but will not impact upstream recharge of groundwater and leaching of contaminants.
		Vertical Barriers	Slurry Wall	No	Hydrogeology of the site would limit the effectiveness of a slurry wall.
			Vibrating Beam Bitumen Grout Wall	No	Forms barrier of uncertain integrity, due to difficulty in sealing base of wall.
			Grout Curtain	No	Forms barrier of uncertain integrity.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater (cont.)	Containment (cont.)	Vertical Barriers (cont.)	Metallic Sheet Piling	No	Presence of storm and sewers in area will not allow driving of sheet pile.
			Concrete wall	No	Subject to cracking due to freeze/thaw stresses.
		Horizontal Barriers	Block Displacement	No	Horizontal barrier is not effective for lateral groundwater movement.
			Grout Injection	No	Technology not sufficiently developed. Produces a barrier of uncertain integrity.
		Gradient Controls	Barrier Wells	Yes	May be effective in containing groundwater and/ or lowering the groundwater table level.
			Interceptor Trenches/ Drains/Sumps	No	Site geology is more conducive to groundwater diversion via wells.
	Collection	Extraction	Extraction Wells	Yes	May be an effective method of collecting groundwater for treatment and/or lowering the groundwater table level.
		Passive Collection	Interceptor Trenches/ Drains/Sumps	No	Site geology is more conducive to groundwater collection via wells.
	On-Site Treatment	Biological Treatment (Aerobic)	Activated Sludge	No	Aerobic biological treatment of chlorinated VOCs is not well documented or effective unless a co-substrate is available.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater (cont.)	On-Site Treatment (cont.)	Biological Treatment (aerobic) (cont.)	Trickling Filters	No	Aerobic biological treatment of chlorinated VOCs is not well documented or effective unless a co-substrate is available.
			Rotating Biological (Contractor)	No	Aerobic biological treatment of chlorinated VOCs is not well documented or effective unless a co-substrate is available.
			Aerated Lagoons	No	Aerobic biological treatment of chlorinated VOCs is not well documented or effective unless a co-substrate is available.
		Biological Treatment (anaerobic)	Anaerobic Digestion	No	Has been shown to dechlorinate contaminants, but may require additional treatment.
			Anaerobic Fluidized Bed	No	Has been shown to dechlorinate contaminants, but may require additional treatment.
		Biophysical Treatment	PACT Treatment	No	Aerobic biological treatment of chlorinated VOCs is well documented or effective unless a co-substrate is available.
			Aerobic Carbon Fluidized Bed	No	Aerobic biological treatment of chlorinated VOCs is well documented or effective unless a co-substrate is available.
		Chemical Treatment	Neutralization	No	Not applicable due to contaminant characteristics.
			Precipitation	No	Not applicable due to contaminant characteristics.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater (cont.)	On-Site Treatment (cont.)	Chemical Treatment (cont.)	Dechlorination	No	Has been shown to be effective, but would require additional treatment.
			Oxidation	No	Technology is appropriate but prohibitively expensive.
			UV Enhanced Oxidation	No	Technology is appropriate but prohibitively expensive.
			Reduction	No	Not applicable due to contaminant characteristics.
		Physical Treatment	Coagulation/ Sedimentation	No	Not applicable due to contaminant characteristics.
			Carbon Adsorption	Yes	Proven effective in removing VOCs.
			Activated Alumina Adsorption	No	Not applicable due to nature of contamination.
			Ion Exchange	No	Not applicable due to nature of contamination.
			Reverse Osmosis	No	Not applicable due to nature of contamination.
			Air Stripping	Yes	Proven effective in removing VOCs.
			Steam Stripping	No	Effective in removing VOCs, but air stripping would prove more cost effective.
			Filtration	No	Not applicable due to nature of contamination.
			Dissolved Air Flotation	No	Not applicable due to nature of contamination.

TABLE 5.2

INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Environmental Media	General Response Action	Remedial Technology	Process Option	Retain For Further Analysis	Screening Comments
Groundwater (cont.)	On-Site Treatment (cont.)	Physical Treatment (cont.)	Extraction	No	Generates additional contamination in wastewater stream. Inefficient means of water treatment.
			Solar Evaporation	No	Not applicable due to site conditions and nature of contamination.
			Spray Evaporation	No	The No Action Alternative will be carried through to the Detailed Analysis of Alternatives.
	Effluent Disposal	Publicly owned treatment works (POTW)	Not Applicable	Yes	May be appropriate for disposal of groundwater.
		Direct Discharge	Not Applicable	Yes	May be appropriate if contaminant levels are sufficiently reduced. Requires NPDES permit.
		Reinjection for Soil Flushing	Injection Wells or Reinfiltration Galleries	Yes	May be appropriate if contaminant levels are sufficiently reduced. Requires reinjection permit or permit exemption.
		In-Situ Treatment	Microbial Degradation	No	Lack of performance data on chlorinated contaminants.
			Chemical Treatment	No	Not applicable due to nature of contamination.